

## BIBLIOGRAPHICAL NOTICES.

*The British Desmidiæ.* By JOHN RALFS, M.R.C.S. Pp. xxii. & 226. Tab. 35. 8vo. Reeve, Benham and Reeve, 1848.

THE foundation of this admirable work was laid in a series of papers read before the Botanical Society of Edinburgh and published from time to time in this Journal. The figures and a great portion of the descriptive matter were most unfairly appropriated by the author of a treatise on the 'British Freshwater Algæ,' who seemed to think that as he was engaged on the subject, no one else had a right to interfere with it, and that every one in possession of information, the fruit of his own industry and observation, was obliged to forego the publication of such materials in a separate form and at once give up the possession of it to him. The matter was treated by us at the time with far more lenity than it deserved, and the almost universal sense of the propriety of our criticism has fully justified the approbation with which those most competent to judge of the subject received our comments. We should indeed have grieved had the treatment which he met with discouraged Mr. Ralfs in his well-directed labour and prevented his undertaking the task which he has now brought, after almost infinite pains, and we fear with little remuneration, to such a brilliant consummation.

No country has contributed more perhaps to the knowledge of Algæ than our own. Commencing with the magnificent works of Turner and of Dillwyn, we have by the labours of Borrer, Hooker, Griffiths and other excellent observers recorded in English Botany, and in more recent times of Greville, Harvey, Berkeley, Hassall, Ralfs and Thwaites, a succession of observations illustrating in turn every group of this great and important natural order. Even before the improvement of our microscopes, which has thrown so much light on every branch of natural history, there were keen observers amongst us who anticipated some of the most curious modern discoveries. Captain Carmichael for instance at Appin, at a distance from all sources of information, without a single neighbour sympathizing in his pursuits, and with a microscope of very imperfect construction, ascertained the real structure of the fructification of Fuci as appears from the manuscript now before the writer of these remarks; but unfortunately the publication of this and others of his discoveries was prevented by the derangement to which the book trade was subject a year or two before his death, which took place in 1827.

During the early part of this period indeed it was principally facts and forms which were recorded, affording a storehouse for others out of which to generalize, and most unhappily for the progress of Algology those who used them did so either in ignorance or neglect of each other's labours. Thus the elder Agardh's system, which was for a long time implicitly received, was formed without due reference to the numerous treatises of the French algologists. In later times indeed Greville acquired very correct general views of the affinities

of Algæ, and defined many new genera, which have been for the most part adopted; and had he carried on his botanical pursuits to a still more recent period, when the improvement of the microscope would have corrected many points in regard of minute structure which were scarcely before within the grasp of the observer, there can be no doubt that he would have ranked as one of the first algologists of the day. He commenced too a series of correct illustrations of *Diatomaceæ*, but his observations in this direction, though the most valuable which had then appeared, seem to have been checked by growing notions of the animal nature of the lower Algæ. The neighbouring group of *Desmidiæ*, though containing some of the most curious and beautiful forms in nature, had all along, with very few exceptions, been unaccountably passed by without examination. Turpin's and Meyen's observations were neglected or disbelieved, while Kützing's, Meneghini's, and above all Brébisson's treatises seem to have been almost unknown. The memoirs of the two former indeed were accessible enough, but the credit attached in this country to Ehrenberg's notions as to the animal nature of these bodies seems very much to have turned aside the attention of botanists from them, while they were not adopted by the zoologists, but were left to be admired and then laid aside by the mere microscopist.

Such very nearly was the state of the subject when the *Diatomaceæ* and *Desmidiæ* were taken up by Mr. Ralfs, who was perhaps the first botanist in England who fully felt the necessity, not merely of ascertaining the general appearance of the threads or frustules as seen immediately under the microscope, but of understanding the form of their sections with a view to the complete development of their structure. This, with the older microscopes, was almost impossible, as the utmost clearness and definition of outline is necessary for this point, and even with all modern helps and appliances the necessary manipulation is difficult enough. Mr. Ralfs however was no less gifted with tact than perseverance, and thus some of the most anomalous appearances were resolved into very simple phenomena. In the course of his observations he found daily more and more reason to believe in the vegetable nature, more especially of the *Desmidiæ*, a belief as regards the latter amounting at last to perfect conviction from the discovery, peculiarly his own, except as regarded the long anomalous *Closteria*, of a mode of propagation, extending through the whole group, by means of the conjugation of distinct individuals after the manner of the *Conjugatæ*. Mr. Thwaites, whose interesting discoveries have already been recorded in our Journal, has now extended this to *Diatomaceæ*, so that, together with the Corallines, there is at the present period no doubt, except as regards one or two *Hæmatococci*, of the vegetable nature of the whole order of Algæ.

But not only has this discovery thrown light upon the real affinities of these productions, but as regards generic and specific distinctions it is of no less importance, for strongly as the mode of conjugation resembles that of *Zygnema* and its allies, the mode of propagation and indeed the actual physical value of the bodies is not the

same. In *Conjugatæ* the spores germinate, and by the development of the first shoots produce a new individual, but in the *Desmidiæ* (at least as indicated by *Closterium*\*) and *Diatomaceæ*, the reproductive bodies, which in the former case often assume forms altogether at variance with those of the perfect plant, and in both are generally of a very different size, appear rather to be contracted fronds which, without any actual germination, by the mere production of articulations produce new individuals. And hence in specific discrimination it is absolutely necessary to know the whole of the phases through which a species passes, exhibiting great varieties of size and form, before it is possible to determine what are specific characters and what are not; and thus many a puzzling appearance, which was before quite inexplicable, becomes clear and instructive.

Mr. Ralfs however holds, and we believe rightly, that the mode of production of the cells in some other tribes of *Algæ* ultimately follows the same type.

“In the *Desmidiæ*,” he says, “the multiplication of cells by repeated transverse division is full of interest, both on account of the remarkable manner in which it takes place, and because it unfolds, as I believe, the nature of the process in other families, and furnishes a valuable addition to our knowledge of their structure and physiology.”

“The compressed and deeply constricted cells of *Euastrum* offer most favourable opportunities for ascertaining the manner of the division; for although the frond is really a single cell, yet this cell in all its stages appears like two, the segments being always distinct, even from the commencement. As the connecting portion is so small, and necessarily produces the new segments, which cannot arise from a broader base than its opening, these are at first very minute, though they rapidly increase in size. The segments are separated by the elongation of the connecting tube, which is converted into two roundish hyaline lobules. These lobules increase in size, acquire colour, and gradually put on the appearance of the old portions. Of course, as they increase the original segments are pushed farther asunder, and at length are disconnected, each taking with it a new segment to supply the place of that from which it has separated.

“It is curious to trace the progressive development of the new portions. At first they are devoid of colour, and have much the appearance of condensed gelatine, but as they increase in size the internal fluid acquires a green tint, which is at first very faint, but soon becomes darker; at length it assumes a granular state. At the same time the new segments increase in size and obtain their normal figure; the covering in some species shows the presence of puncta or granules; and lastly, in *Xanthidium* and *Staurastrum* the spines

\* See Morren's memoir in the 5th volume of the Second Series of 'Annales des Sciences Naturelles.' A second mode of propagation appears to be indicated by Mr. Ralfs at tab. 27. In other *Desmidiæ* the development of the spores has we believe not been yet ascertained, but from analogy we believe that it will prove similar to that of *Diatomaceæ*.

and processes make their appearance, beginning as mere tubercles, and then lengthening until they attain their perfect form and size; but complete separation frequently occurs before the whole process is completed. This singular process is repeated again and again, so that the older segments are united successively, as it were, with many generations. In *Sphærozozma* the same changes take place, and are just as evident, but the cells continue linked together, and a filament is formed, which elongates more and more rapidly as the joints increase in number. This continued multiplication by division has its limits; the segments gradually enlarge whilst they divide, and at length the plant ceases to grow; the division of the cells is no longer repeated; the internal matter changes its appearance, increases in density, and contains starch-granules which soon become numerous; the reproductive granules are perfected, and the individual perishes. In a filament the two oldest segments are found at its opposite extremities; for so long as the joints divide they are necessarily separated further and further from each other. Whilst this process is in progress the filament in *Sphærozozma* consists of segments of all sizes; but after it has reached maturity there is little inequality between them, except in some of the last-formed segments, which are permanently smaller. The case is the same with those genera in which the separation of the cells is complete. I admit that the division of the cells just described apparently differs greatly from that in other simple Algæ; but I believe that the process in all is essentially the same, and that whatever differences exist are modifications necessarily resulting from the different forms of the cells. In the examples already given the cell itself consists of two distinct portions, having a constriction between them; hence each of the new-formed portions is similarly distinct from the older one which forms it and to which it is united.

“ In order fully to elucidate the subject, cells may be distributed into three principal kinds, distinguished by their form :

“ 1st. Bipartite cells, already described, and more or less constricted at the middle ;

“ 2nd. Cells globose or rounded at the ends, or having the extremities attenuated ;

“ 3rd. Cylindrical cells.

“ Bipartite cells belong only to the *Desmidiæ*; cells globose or roundish at the ends are seen in the *Nostocs* and *Palmelleæ*; attenuated cells in the *Desmidiæ*; and cylindrical ones in the *Conjugatæ*, *Tiresias*, &c.

“ It is obvious that the new portions must arise from the whole of the junction margin of the original valves; consequently when the junction occupies only a part of the breadth the new portion will be narrower than the old; but when the junction of the valves is as broad as the cell, the new portion will from the beginning be of the same breadth. From this important fact, we may explain the different sorts of division. Since in the two latter kinds of cell the valves are united by their entire breadth, the new portions cannot be distinguished by their size, we must therefore have recourse to other

aids to enable us to trace the changes and satisfy ourselves of their real identity with that already described ; and I hope to be able to show that this identity does exist.

“ In *Nostoc* and *Anabaina* the cells are globular, and as there is no constriction we might remain ignorant of the real method of division ; but, guided by the analogical process in the *Desmidiæ*, I hope to make it sufficiently plain. The hemispheres are thrust apart by the new formation ; but now it is the outer rounded margin that we look to for an explanation. If a globe be cut into two equal portions, each will represent half a circle. By comparison with the neighbouring cells, we find that these two half circles remain unaltered, and are merely separated from each other, for if again brought together they would reconstitute the former globe. The new formations however separate them further and further, until the intervening space equals that occupied by the original globe, and then we find two globes exactly like the primary one, the internal half of each being the newly-formed one. During this time the inner portions, as they extend, develop more and more of the circle, until each becomes, as I have stated, a perfect hemisphere. The whole process cannot, of course, be seen in the same cell ; but in a dividing filament some joints may be observed in one stage and some in another, which renders the evidence complete.

“ When the cell is oblong, or only rounded at the extremities, the process, though similar, is less evident : the cell at first seems merely to elongate until it obtains nearly twice its original length, when the division commences and the rounding of the new ends becomes apparent. The tapering cell presents but little difference, for the separation takes place before its extremities are fully developed. Sometimes these cells separate obliquely, as in *Spirotania* and *Scenedesmus*.

“ I ought to state however that the opinions advocated above do not agree with those of M. De Brébisson, who has attained so high a reputation for his intimate acquaintance with the freshwater Algæ, and to whose kindness I have been so often indebted during the progress of the present work. He considers that there is an essential distinction in the mode of division between the *Desmidiæ* and *Nostochinæ* (including in the latter the *Palmelleæ*), and that from it indeed differential characters are obtained by which we can distinguish these nearly-allied groups. He observes of *Hormospora multabilis*, Bréb.\*, ‘ Ils sont le plus souvent géminés, se multipliant par une division spontanée (déduplication) transversale, comme cela arrive dans quelques autres Pleurococcoidées. Une division analogue a lieu dans les Desmidiées, auxquelles on serait d’abord tenté de rapporter les Hormospora ; mais les demi-corpuscules (hémisomates) des Desmidiées développent à leur point de séparation une nouvelle portion semblable à la première, tandis que, dans l’accroissement des Nostocinées, les corpuscules sont divisés en deux par un étranglement transversal, sans qu’il s’ensuive une reproduction sur

\* Annales des Sciences Naturelles, Jan. 1844.

chacun des points de rupture. Il y a dans ce cas, comme je l'ai dit ailleurs, *déduplication simple*. Dans les Desmidiées, il y a *déduplication et reduplication*.'"

"It is with unfeigned diffidence that I venture to dissent from the opinion of one possessing so profound a knowledge of these tribes, and I do so only from conviction, the result of close and repeated investigations.

"I have stated my belief that the same changes occur in both the *Desmidiæ* and the *Nostochinæ*. A cell in *Micrasterias* has two hemispheres, just as a joint in *Anabaina* has; in both these separate, and in both each hemisphere becomes again a perfect sphere; and if in *Micrasterias* the two hemispheres were united by their whole bases, there would not remain even an apparent difference between them.

"The form of the cylindrical cells no longer helps us in tracing the method of division. In *Penium* as in the *Conjugatæ*, they seem merely to elongate and then divide. As I formerly suggested, in a paper read before the Botanical Society of Edinburgh, I consider it extremely probable that in all the simple Algæ the cell or joint consists of two valves, and that additions occur at their junction, the original parts remaining unaffected: but this it may never be possible to demonstrate satisfactorily, unless a species of *Conferva* with a coloured integument should be detected, or some means can be devised for permanently colouring the filaments without impairing their growth. Then indeed the question might be determined; at present I can merely show the probability that the cell in cylindrical species of *Desmidiæ* agrees with the joint in a *Zygnema* or *Tyndaridea*; since whenever the covering is colourless and free from markings not the slightest difference can be perceived. This is the case in a few species of *Penium*; and hence *Penium Brebissonii* is by some authors placed in the *Palmelleæ*. In *Penium margaritaceum* and *Penium Cylindrus* the integument is coloured, and we are enabled, by means of the paler appearance of the newly-formed portions, to satisfy ourselves that in these also each half of the original cell is acquiring during the division a new partner. In *Didymoprium* the same fact is rendered apparent, because the suture passes between minute teeth; these teeth recede from each other, and the new teeth which appear between them show the place where the separation of the joint has occurred."

To these interesting observations it may be added that the order of development in *Diatomaceæ*, where the frustules adhere long enough together to show their progress, is precisely the same. In *Isthmia*, for instance, if the several segments of the thread be indicated by symbols expressing the order of their development, the same symbols would equally express the same phenomena in a thread of *Sphærozosma*.

Many other matters of interest are discussed in the Introduction, such as the claims of these bodies to be ranked amongst vegetables, the nature of the active molecules at the apex of the frustules of *Closterium*, the swarming of the articulations of *Scenedesmus*, the mode

of preserving specimens for microscopical observation which has been so extensively and successfully carried out by Mr. Thwaites, &c., for information on which we must refer our readers to the work itself. The long extract we have given will sufficiently show the style and powers of reasoning of our author. The introduction was unfortunately written and printed before the descriptive-matter, which precluded the possibility of putting the last finishing touch, on the completion of the work, which is often of such immense value in giving the proper effect to the whole. It is impossible to read it without feeling this, especially as the brilliant discoveries of Mr. Thwaites on the conjugation of *Diatomaceæ* were made before the publication of the volume, and which would have given Mr. Ralfs new ground for thought and comparison, discoveries now extended to the spores of *Palmellæ*.

Of the general execution of the work we cannot speak too highly: the descriptions are accurate and copious, the species well-defined, the synonyms carefully scrutinized, every available source of information ransacked, and the figures, for which it is principally indebted to Mr. Jenner, beautiful and accurate. The whole tone of the book too is exactly that manly tone at once of modest candour and of self-respect, which shows the faithful and conscientious observer confident in his own carefulness and measure of ability, but aware of the liability to error which is inseparable from man's nature.

It is a book not merely for the algologist but for the physiologist, and in the spores of these curious productions the geologist will recognise the bodies which are so prevalent in flints. Fossil fronds of *Desmidiæ* have been found by Professor Bailey, who detected various species of *Closterium* and *Euastrum* in calcareous marls collected in New Hampshire and New York by Professors Hubbard and Hall, and also in marl at Scotch Town, New York, by Mr. Connors. Professor Bailey informed Mr. Ralfs that the specimens from the last-named station were taken from below the bones of *Mastodon giganteus*. As sporangia of the *Desmidiæ* and other membranous bodies in a fossil state have lately been detected by Mr. Deane and Dr. G. Mantell in the gray chalk of Folkestone, it is probable that a careful search in that neighbourhood would also bring to light the fossil fronds of *Desmidiæ*.

We are not aware that any *Desmidiæ* have yet been found in amber. A list of *Diatomaceæ* contained in that curious substance was lately given in our Journal. These were communicated to Ehrenberg by Dr. Thomas of Berlin, and specimens containing the same species have been entrusted by Dr. Thomas to the writer of these remarks; but in a very extensive list of specimens prepared by Dr. Thomas now in our hands, it does not appear that any *Desmidiæ* have yet been detected, nor is there any indication of the kind in the work of Dr. Berendt.

It remains only that we recommend most cordially the work of Mr. Ralfs to the attention of our readers, assuring them that they will not be disappointed in it; and to express our hope that it will shortly be followed by a similar volume on the *Diatomaceæ*.